

CLAIMS

What is claimed is:

- 1 1. An apparatus for use in a system for supercritical processing of an object with a fluid,
2 comprising:
3 means for injecting a processing chemistry into the system, including means for
4 starting and means for stopping the means for injecting; and
5 means for substantially preventing fluid from re-entering the means for injecting.
- 1 2. The apparatus of claim 1 wherein the means for injecting comprises means for injecting
2 at a predetermined pressure.
- 1 3. The apparatus of claim 2 wherein the predetermined pressure is in a range of
2 approximately 2300 psi to approximately 3000 psi.
- 1 4. The apparatus of claim 2 wherein the means for injecting further comprises at least one of
2 a pump, a first backflow-prevention means for substantially preventing backflow of the
3 processing chemistry, and a second backflow-prevention means for substantially
4 preventing backflow of the processing chemistry.
- 1 5. The apparatus of claim 4 wherein at least one of the first backflow-prevention means and
2 the second backflow-prevention means comprises at least one check valve.
- 1 6. The apparatus of claim 1 wherein at least one of the means for starting and the means for
2 stopping comprises a flow-control means.
- 1 7. The apparatus of claim 6 wherein the flow-control means comprises at least one of a
2 valve, a pneumatic actuator, an electric actuator, a hydraulic actuator, and a micro-electric
3 actuator.

- 1 8. The apparatus of claim 1 wherein the means for substantially preventing fluid from re-
2 entering the means for injecting is operative when at least one of the means for stopping
3 is active and the means for starting is active.
- 1 9. The apparatus of claim 8 wherein the means for substantially preventing fluid from re-
2 entering the means for injecting comprises a back-pressure regulator.
- 1 10. The apparatus of claim 1 wherein the object is a semiconductor wafer for forming
2 integrated circuits.
- 1 11. The apparatus of claim 1 further comprising a fluid source in fluid flow communication
2 with the means for injecting.
- 1 12. The apparatus of claim 1 further comprising a fluid supply means for supplying the
2 processing chemistry to the means for injecting.
- 1 13. The apparatus of claim 12 wherein the processing chemistry is at least one of gaseous,
2 liquid, supercritical and near-supercritical carbon dioxide.
- 1 14. The apparatus of claim 13 wherein at least one of solvents, co-solvents and surfactants are
2 contained in the carbon dioxide.
- 1 15. The apparatus of claim 12 wherein the fluid supply means comprises at least one of a
2 fluid mixer, a first fluid source, a valve for controlling a flow of a first fluid from the first
3 fluid source, a second fluid source, and a valve for controlling a flow of a second fluid
4 from the second fluid source.
- 1 16. A system for supercritical processing of an object with a fluid, comprising:
2 a high-pressure process chamber;
3 means for injecting a processing chemistry into the high-pressure process chamber
4 including means for starting and means for stopping the means for injecting; and
5 means for substantially preventing fluid from re-entering the means for injecting.

- 1 17. The system of claim 16 wherein the means for injecting comprises means for injecting at
2 a predetermined pressure.
- 1 18. The system of claim 17 wherein the predetermined pressure is in a range of
2 approximately 2300 psi to approximately 3000 psi.
- 1 19. The system of claim 16 wherein the means for injecting includes at least one of a pump, a
2 first backflow-prevention means for substantially preventing backflow of the processing
3 chemistry, and a second backflow-prevention means for substantially preventing
4 backflow of the processing chemistry.
- 1 20. The system of claim 19 wherein at least one of the first backflow-prevention means and
2 the second backflow-prevention means comprises at least one check valve.
- 1 21. The system of claim 16 wherein at least one of the means for starting and means for
2 stopping comprises a flow-control means.
- 1 22. The system of claim 21 wherein the flow-control means comprises at least one of a valve,
2 a pneumatic actuator, an electric actuator, a hydraulic actuator, and a micro-electric
3 actuator.
- 1 23. The system of claim 16 wherein the means for substantially preventing fluid from re-
2 entering the means for injecting is operative when at least one of the means for stopping
3 is active and the means for starting is active.
- 1 24. The system of claim 23 wherein the means for substantially preventing fluid from re-
2 entering the means for injecting comprises a back-pressure regulator.
- 1 25. The system of claim 16 further comprising means for circulating a fluid, wherein the
2 means for circulating a fluid is coupled to the high-pressure process chamber.

- 1 26. The system of claim 16 further comprising a process control computer coupled for
2 controlling at least one of a valve, a pneumatic actuator, an electric actuator, a hydraulic
3 actuator, a micro-electric actuator, a pump, and a back-pressure regulator.
- 1 27. The system of claim 16 wherein the object is a semiconductor wafer for forming
2 integrated circuits.
- 1 28. The system of claim 16 wherein the processing chemistry is at least one of gaseous,
2 liquid, supercritical and near-supercritical carbon dioxide.
- 1 29. The system of claim 28 wherein at least one of solvents, co-solvents and surfactants are
2 contained in the carbon dioxide.
- 1 30. A supercritical processing system for processing a semiconductor wafer with a fluid, the
2 fluid being from a fluid source, the system comprising:
3 a. a circulation loop coupled to a high-pressure processing chamber; and
4 b. an inlet line for introducing the fluid into the circulation loop, the inlet line
5 including:
6 i. an inlet port in the circulation loop;
7 ii. a back-pressure regulator coupled to the inlet port;
8 iii. a pump for compressing the fluid to form a pressurized fluid;
9 iv. a first line for transferring the pressurized fluid from the pump to the back-
10 pressure regulator, the first line configured to maintain a uni-directional
11 flow of the pressurized fluid from the pump towards the back-pressure
12 regulator; and
13 v. a second line for transferring a quantity of the fluid from the fluid source
14 to the pump, the second line configured to maintain a uni-directional flow
15 of the fluid from the fluid source to the pump.

- 1 31. A method of regulating a flow of a processing chemistry into a system for supercritical
2 processing of an object with a fluid, comprising the steps of:
- 3 a. supplying the processing chemistry to a pump for compressing the processing
4 chemistry to form a pressurized fluid;
- 5 b. providing a start-stop system for controlling an inlet line for introducing the
6 processing chemistry into the system, such that when a start mode is active the
7 pressurized fluid is introduced into the system, and such that when a stop mode is
8 active the pressurized fluid is not introduced into the system;
- 9 c. maintaining a flow of the pressurized fluid when the start mode is active; and
10 d. preventing a fluid within the system from entering the inlet line while at least one
11 of the start mode and the stop mode is active.
- 1 32. The method of claim 31 wherein the step of maintaining a flow of the pressurized fluid
2 comprises operating the pump such that a predetermined quantity of the processing
3 chemistry is introduced into the system.
- 1 33. The method of claim 32 wherein the predetermined quantity of the processing chemistry
2 is introduced into the system at a predetermined pressure.
- 1 34. The method of claim 33 wherein the predetermined pressure is in a range of
2 approximately 2300 psi to approximately 3000 psi.
- 1 35. The method of claim 31 wherein the step of preventing a fluid within the system from
2 entering the inlet line comprises providing a back-pressure regulator.
- 1 36. The method of claim 31 wherein the object is a semiconductor wafer for forming
2 integrated circuits.
- 1 37. The method claim 31 wherein the processing chemistry is at least one of gaseous, liquid,
2 supercritical and near-supercritical carbon dioxide.

1 38. The method claim 33 wherein at least one of solvents, co-solvents and surfactants are
2 contained in the carbon dioxide.

1 39. The method claim 31 further comprising performing at least one of a supercritical
2 cleaning process and a supercritical rinsing process.